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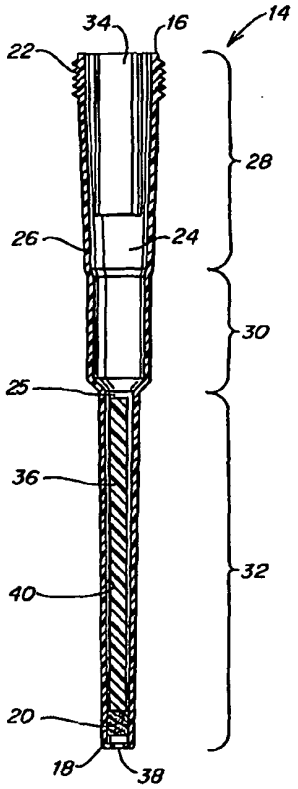
(57) Abstract

A pipettor including a body portion, a cylinder having an interior channel, and a filter plug disposed within the channel is disclosed. The filter plug may include a plurality of pores and may preferably be treated with a first chemical, so as to affect closure of the pores when the filter plug contacts a pipetted fluid. The pore closure helps contain leakage of the fluid into the pipettor by sealing the pipettor to addtional fluid flow. The filter plug may also be treated with a second chemical to affect a change in the color of the filter plug upon contact with the pipetted fluid. The color change acts as a signal to an operator that possible contamination of the pipettor has occurred. The color change and/or closure may also be affected by an aerosol generated from the pipetted fluid.



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PIPETTOR INCLUDING AN INDICATOR AND METHOD OF USE

Background

Technical Field

The present application relates to pipettor and pipetting, and more particularly to a pipettor including an indicator filter.

Background of Related Art

Pipettors are widely utilized in laboratories for taking up and discharging precise quantities of fluid. Automated pipettors generally include a motor for actuating a piston, the piston being housed in a cylinder and open to the tip of the pipettor. Generally, two methods of pipetting are practiced, positive displacement pipetting and air displacement pipetting. In positive displacement pipetting the fluid to be pipetted is in direct contact with the base of the piston and the cylinder in which the piston moves. The piston and walls of the displacement cylinder of the pipettor are therefore exposed, or contaminated, with the fluid being pipetted, which may be unacceptable in certain applications. Positive displacement pipettors should, therefore, be regularly cleaned or should utilize disposable pistons and cylinders to avoid cross-contamination of samples.

The more common method of pipetting is the air displacement method which utilizes an air buffer between the base of the piston and the fluid present in a disposable pipette tip, which is attached to one end of the pipettor. In air displacement pipetting, the piston and cylinder in which the piston moves are not intended to be exposed to the fluid being pipetted, as the fluid is generally confined within the disposable pipette tip. Thus, the piston and cylinder need not be replaced or thoroughly cleaned after every use. Even in air displacement pipetting, however, some contamination of the piston and cylinder may occur if either the fluid itself, or aerosol from the fluid, comes into contact with the piston and/or cylinder. This can occur if the operator inadvertently overfills the disposable tip, or if the fluid is agitated in such a manner as to create aerosol fumes. In such situations the piston and/or cylinder may need to be cleaned or possibly replaced.

It some instances it may be difficult for an operator to determine if the cylinder or piston has become contaminated, especially if contamination is due to aerosols formed by the fluid. In

addition, if overfilling has occurred, containing the fluid before it reaches the piston or beyond, would be desirable.

There is therefore a need in the art for a device which indicates contamination of a pipettor to an operator and which helps to limit the extent of overfilling, so as to contain such contamination.

Summary

A pipettor including a body portion, a cylinder having an interior channel, and a filter plug disposed within the channel is disclosed. The filter plug may include a plurality of pores and may preferably be treated with a first chemical, so as to affect closure of the pores when the filter plug contacts a pipetted fluid, thereby sealing the channel containing the filter. The pore closure helps contain further leakage of the fluid into the pipettor by sealing the pipettor to additional fluid flow. The filter plug may also be treated with a second chemical to affect a change in the color of the filter plug upon contact with the pipetted fluid. The color change acts as a signal to an operator that possible contamination of the pipettor has occured. The color change and/or closure may also be affected by an aerosol generated from the pipetted fluid.

In one embodiment, the fluid is water or an aqueous based fluid.

In another embodiment, the cylinder includes a tip fitting configured and adapted for use with a disposable pipettor tip.

In another embodiment, the cylinder is removably attached to the body portion.

In another embodiment, the filter plug is cylindrical in shape and is friction fitted within the interior channel.

Brief Description of The Drawings

Various embodiments are described herein with reference to the drawings, wherein:

Figure 1 is a schematic of a pipettor including a filter plug in accordance with the present invention;

Figure 2 is an elevation view in partial cross-section of a cylinder including a filter plug of the embodiment of Fig. 1;

Figure 3 is an enlarged, perspective view of the filter plug of the embodiment of Fig. 1; and

Figure 4 is a schematic of a pipettor containing fluid which has been pipetted and which has passed through the filter plug of the embodiment of Fig. 1 and into the cylinder.

Detailed Description of The Preferred Embodiments

Referring initially to Fig. 1, there is illustrated an automated pipettor **10** utilized for air displacement pipetting and including a body portion **12** and a cylinder **14**. Fig. 1 is a representative pipettor only, the embodiment of Fig. 1 being commercially available under the brand name Impact® from Matrix Technologies Corporation, located in Lowell, MA. It should be understood that any number of air displacement pipettor designs, whether manual or automated, and available from a variety of manufacturers, may be utilized in accordance with the present invention.

With continued reference to Fig. 1 in conjunction with Fig. 2, cylinder **14** includes a first end **16** for connection to body portion **12** and a second, or tip fitting end **18** for connection to a disposable pipette tip **19**, the tip fitting end including a filter plug **20** disposed therein. Cylinder **14** may be any of a number of volumes, with volumes of 12.5, 30, 125, 250, and 1250 microliters being conventional, and with a 1250 microliter pipettor being illustrated in the present embodiment. First end **16** preferably includes a threaded section **22** for engagement with corresponding threads (not shown) formed in body portion **12**, for releasably securing the cylinder to the body portion. Alternately, other connection methods may be utilized, for example a bayonet connection, as is well know to one of skill in the art.

Cylinder **14** preferably defines an interior chamber **24** and a communication channel **25**, for communication between the pipettor **10** and disposable tip **19**. Cylinder **14** may be tapered and include an outer wall **26** having a stepped configuration, as in the illustrated embodiment. The stepped configuration of outer wall **26** may divide chamber **24** into an upper portion **28**, a mid-portion **30**, and a lower portion **32**, all three portions being in communication with each other. Alternately, cylinder **14** may not have a stepped configuration, or may have greater than, or less than three portions defined by the stepped configuration illustrated in Fig. 2. In the present embodiment, a piston **34** may be actuated to move within chamber **24**, between the upper and mid-portions **28**, **30** during intaking and dispensing of fluid. The piston **34** preferably does not enter the communication channel **25** defined by lower portion **32**, as the lower portion is preferably elongated, and the channel is therefore preferably smaller than the outer diameter of the piston **34**.

Communication channel **25** may include a rod **36** disposed therein, the rod being made of plastic and utilized to take up dead air space, i.e. the air not used in the act of pipetting. Also disposed within channel **25**, preferably adjacent tip fitting end **18** and aperture **38**, is filter plug **20**. In the present embodiment, filter plug **20** is configured and dimensioned to fit within communication channel **25** and may be held in place by friction between the surface of the filter plug and the interior surface **40** of the lower cylinder portion. Alternately, other devices for taking up dead air space, may be utilized, for example, filter plug **20** may be configured and dimensioned to take up the dead air space, as well as performing as an indicator and containment device.

Referring now to Fig. 3, the filter plug **20** may be cylindrically shaped, and preferably is approximately 1/8 to 1/4 of an inch in height, "h", and approximately 1/16 to 1/4 of an inch in diameter, "d". For use in a 1250 µl pipettor, filter plug **20** is approximately 1/4 of an inch in height and approximately 1/5 of an inch in diameter. It should be understood that other shapes and sizes are contemplated, provided, however, that the filter plug **20** should be configured and dimensioned to fit within tip section **32**. In the present embodiment, the filter plug **20** may be made of a sintered polyethylene material available from General Polymeric of Reading, PA, the material preferably including a plurality of pores, as partially represented by pores **42**. Filter plug **20** is preferably treated with a first chemical during compounding and prior to molding, to affect closure of the pores, and may additionally be treated with a second chemical preferably after molding, to affect color change of the plug, both chemicals reacting when the filter plug contacts water or any aqueous fluid. The color change and/or closure may also be affected by an aerosol generated from the aqueous fluid, in the present embodiment. It should be understood that filter plug **20** is preferably chemically treated to react with aqueous fluids because these fluids represent the majority of fluids pipetted. Filter plug **20** may, however, be chemically treated to react to any of a variety of fluids or chemicals, depending upon the desired application. In addition, the filter plug **20** may be treated with either or both of the chemicals, such chemically treated, sintered polyethylene materials also being available from General Polymeric.

Filter plug **20** preferably is composed of a porous, sintered polyethylene material, the sintered polyethylene material being hydrophobic. Prior to contacting water or an aqueous fluid, the plurality of pores **42** allow fluid and air to pass therethrough. Before molding, as part of the compounding process, the polyethylene material is treated with a first, hydrophilic chemical, so that upon contact of the fluid with plug **20**, the fluid passes through the pores and initiates a

reaction with the first chemical. This reaction causes the first chemical to close off pores **42** and prevents any further fluid from passing through the plug and into cylinder **14**. The filter plug **20** thus acts to contain the fluid and may prevent fluid from contacting the tip of the piston **34**, depending upon the amount of fluid which has passed through the filter, and the position of the piston. Filter plug **20** may, additionally, be treated with a second chemical which affects the color of the plug, when the plug contacts the fluid.

Filter plug **20** may preferably be treated with a second chemical, the filter plug being a first color, prior to contact with the fluid. The chemical utilized may selectively change the first color to a second color, upon contact with the fluid, or aerosols generated from the fluid. In the present embodiment, filter plug **20** is preferably treated with a cobalt-chloride which turns the plug a light-blue color, prior to contact with the fluid. Upon contact with water, or any aqueous fluid, the light-blue color changes to a pink color. Alternate chemical treatments and/or colors may be utilized as is known to one skilled in the art. In addition, the first color may be white or clear and the second color may be a shade of the first color. Thus, if during pipetting, fluid inadvertently enters channel **25** through aperture **38**, for example by overfilling, the fluid will contact the filter plug **20** and affect a change in color of the filter. This change in color acts as a notification to the operator that the cylinder has contacted the fluid, and that contamination may have, therefore occurred.

In operation, a laboratory technician will choose an appropriate size pipettor **10**, the pipettor having a filter plug **20** disposed within communication channel **25**. The technician will then choose a disposable tip **19** having a head portion **44** at one end thereof and an aperture **46** at an opposite end thereof, and fit the head portion over the tip fitting end **18**, such that aperture **46** is in communication with cylinder **14**. The technician is now ready to pipette.

The technician then places disposable pipette tip **19** into a container holding a sample fluid to be pipetted and may input the volume intended to be pipetted, if the pipettor is so designed. The technician then depresses trigger **48** to engage a motor (not shown) disposed within body portion **12**, and the motor actuates piston **34**. Upon actuation of piston **34**, the fluid is drawn into disposable pipette tip **19**, and preferably fills the tip to the desired amount. If, however, the fluid overfills tip **19**, fluid will enter cylinder **14** through aperture **38**, into channel **25** and contact filter plug **20**. In the illustrated embodiment, upon contact of an aqueous fluid with filter plug **20**, the plug begins to change color from blue to pink and also begins to block its pores **42**. As suggested in Fig. 4, once the filter pores are blocked, fluid **50** is trapped above the

filter plug, and no further fluid may flow into the cylinder **14**, as the filter plug has been sealed against fluid flow. Thus, filter plug **20** operates as a visual indicator to the operator of possible contamination by changing color and/or operates to prevent further contamination of the cylinder **14** and/or piston **34** by preventing additional fluid from entering the cylinder.

It will be understood that various modifications may be made to the embodiment disclosed herein. For example, the filter plug may be treated to only change color and may not block fluid entry, or may only block fluid entry and not change color. In addition, although a single channel pipette is illustrated, the filter plug may be inserted into a channel or tip fitting end of a multi-channel pipettor as well. Therefore, the above description should not be construed as limiting, but merely as exemplifications of preferred embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the claims appended hereto.

CLAIMS

1. An air displacement pipettor for pipetting fluid samples, the pipettor including:

a body portion;

a cylinder having a first end attached to the body portion and a second end including an aperture; and

a filter plug disposed within the pipettor, the filter plug being changeable from a first color to a second color upon fluid entering the pipettor and contacting the filter plug.

2. The pipettor according to claim 1, wherein the filter plug further includes a plurality of pores in fluid communication with the aperture in the cylinder.

3. The pipettor according to claim 2, wherein the filter plug includes a material which blocks the plurality of pores to fluid flow upon a fluid entering the pipettor and contacting the filter plug.

4. The pipettor according to claim 3, wherein at least some of the fluid passes through the pores and into the pipettor before the pores are blocked.

5. The pipettor according to claim 1, wherein the filter plug is friction fitted within a tip fitting portion of the pipettor.

6 The pipettor according to claim 5, wherein the tip fitting portion is configured and dimensioned for receipt of a disposable tip.

7. The pipettor according to claim 1, wherein the cylinder is removably attached to the body portion.

8. The pipettor according to claim 1, further comprising a piston disposed within the cylinder.

9. The pipettor according to claim 1, wherein the pipettor is a multichannel pipettor.

10. The pipettor according to claim 1, wherein the fluid is an aerosol.

11. A pipettor cylinder for attachment to a pipettor, the cylinder including;

a first end configured and adapted for attachment to a body portion of the pipettor and a second end including an aperture; and

a filter plug disposed with the pipettor, the filter plug including a plurality of pores, and also including a material which blocks the plurality of pores to fluid flow upon a fluid entering the pipettor and contacting the filter plug.

12. The pipettor cylinder according to claim 11, wherein blocking the plurality of pores seals the pipettor to fluid flow.

13. The pipettor cylinder according to claim 11, wherein at least some of the fluid passes through the filter plug and into the chamber of the cylinder before the filter plug becomes hydrophobic.

14. The pipettor according to claim 11, wherein at least some of the fluid passes through the pores and into the pipettor before the pores are blocked.

15. The pipettor cylinder according to claim 11, wherein the filter plug changes from a first color to a second color upon fluid contacting the filter plug.

16. The pipettor according to claim 11, wherein the filter plug is friction fitted within a tip fitting portion of the pipettor.

17. The pipettor according to claim 16, wherein the tip fitting portion is configured and dimensioned for receipt of a disposable tip.

18. The pipettor according to claim 11, wherein the pipettor is a multichannel pipettor.

19. The pipettor according to claim 11, wherein the fluid is an aerosol.

20. A method of pipetting a fluid comprising the steps of:

providing a pipettor including a body portion, a cylinder including a piston, and a chemically treated filter plug disposed with the pipettor;

attaching a pipette tip to the pipettor such that the pipette tip is in fluid communication with the pipettor;

actuating the piston such that fluid is drawn into the pipette tip;

changing the color of the filter plug from a first color to a second color by contacting the filter plug with the fluid.

21. The method of pipetting a fluid according to claim 21, further comprising the step of sealing the pipettor from fluid communication with the pipette tip by contacting the filter plug with the fluid.

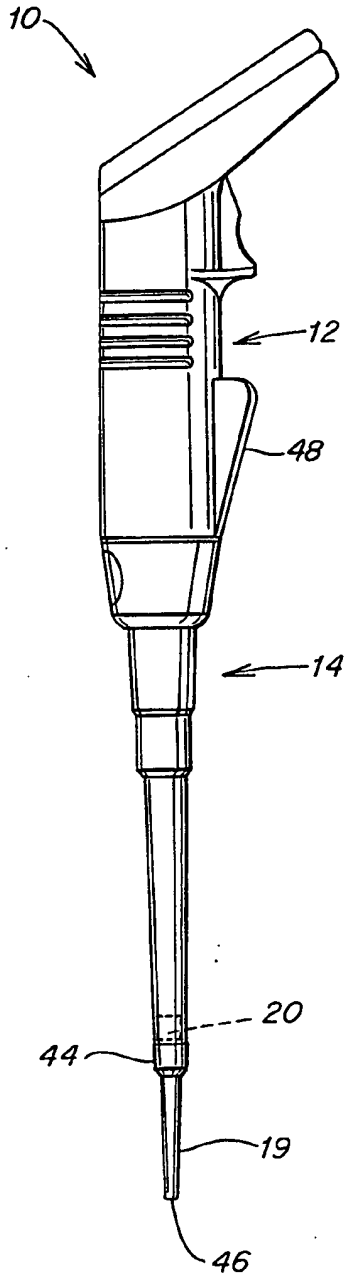

FIG. 1

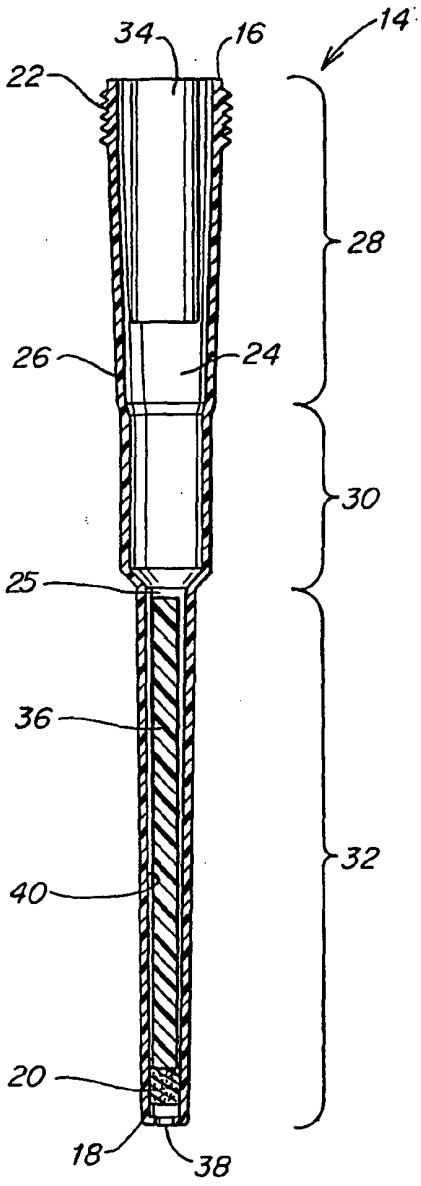

FIG. 2

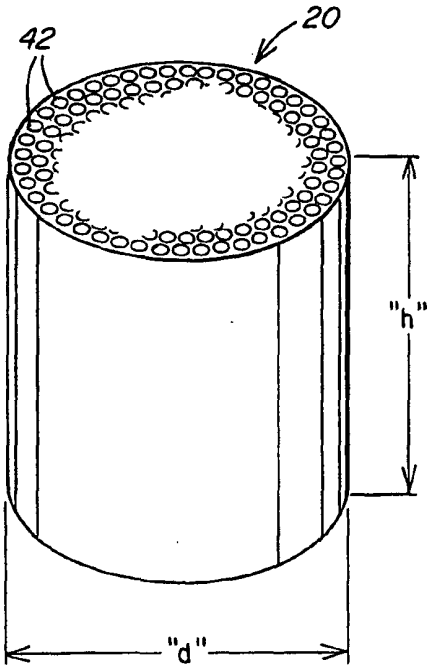

FIG. 3

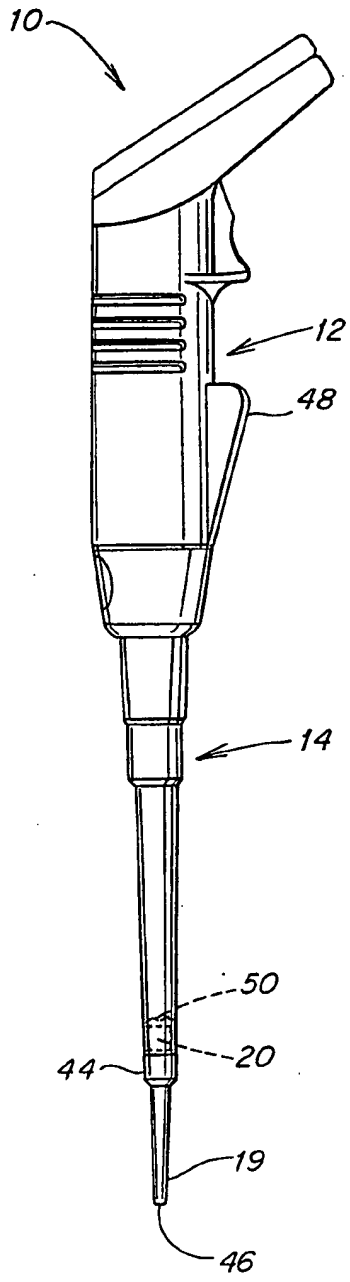

FIG. 4

INTERNATIONAL SEARCH REPORT

Inter ...nal Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B01L3/02 G01N35/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B01L G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 999 164 A (PUCHINGER HERWIG ET AL) 12 March 1991 see column 2, line 57 - column 4, line 4 see column 4, line 19 - column 4, line 24 see column 4, line 50 - column 4, line 57 see column 5, line 27 - column 5, line 66 see column 6, line 37 - column 7, line 33 see column 7, line 45 - column 8, line 30 see figures 1-3,5-7 --- -/--	1-3,5,6, 8,10-12, 15-17, 19,20

[X] Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search	Date of mailing of the international search report
30 March 1998	06/04/1998

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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X	WO 94 20831 A (WAINWRIGHT NORMAN ET AL) 15 September 1994 see page 2, line 28 - page 3, line 36 see page 4, line 20 - page 6, line 31 see page 9, line 4 - page 9, line 24 see page 10, line 5 - page 10, line 20 see page 16, line 9 - page 16, line 34 see figures 1-3	1,2,7
X	US 5 364 595 A (SMITH MICHAEL W) 15 November 1994 see column 1, line 40 - column 1, line 49 see column 1, line 65 - column 2, line 4 see column 2, line 20 - column 3, line 56 see column 4, line 30 - column 4, line 63 see column 5, line 1 - column 5, line 4 see column 5, line 31 - column 6, line 11 see figure 1	11,19

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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